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Transforming Non-Living to Living: A Case on Changing Business Environment

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Abstract

The paper highlights the issues of context aware ubiquitous environment focusing on achieving coherency between sugarcane production system and sugar production process. Web ontology is developed highlighting the coordination of heterogeneous components. A thorough coordination of Ubiquitous environment provides sustainable and efficient sugar recover in mills.

Keywords: Internet of Things (IOT), Sugar mills, GIS, SCADA, XBee

1. Introduction

India is the second largest country in the world in terms of total sugarcane production. States like Uttar Pradesh and Maharashtra are mostly dependent on Sugarcane. In order to provide an efficient collaboration between famers and sugar mills Uttar Pradesh government has developed a system "Sugar Cane Information System (SIS)"[14]. The Software is very comprehensive and widespread catering to 2.9 million sugarcane farmers of 44 districts. There are various enhanced push-pull methodologies of information handling. The impact of sis is tremendous. The total amount of increase in income accounts to Rs. 850 corers (Department

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of Sugar Industries and Sugarcane Development Uttar Pradesh Report)[13]. Our work focuses on automatic collaboration of sugar cane yield and boiler control to optimize the efficiency of the plant.

The linking of the two entities is done by the help of Ontology developed for sugarcane farming and Sugar Manufacturing Process.

2. Literature Survey

Until Now most web pages are limited together using the HTML that relates only to human understandability. As the user desires he/she can move from pages. All the process doesn't support any communication which is understandable to machines. Tim Berner Lee [11] developed a concept of web pages that could be understandable by machines. The Semantic web has revolutionized the basic concepts of web information it has automated the process such that even the machine can understand. The advantage with this feature provides the basis for refinement in context knowledge. The supporting framework for this paradigm shift includes resource description framework (2002) an web ontology language (OWL) (2004). There has been lots of effort in the area of web ontology for Agricultural system. Some prominent work include the work done by (Islam and Piasecki, 2008)[5] Ontology for hydrodynamics (2008). The development of ONT Agria for precision farming (Aqueel-ur-Rehman, Zubair, 2011)[1] describes scalable service oriented agriculture ontology that consists of irrigation and fertilisation on the similar lives (Ittersum et al., 2008)[6] developed a component based framework SEAMLESS. It defines different levels describing about meta-information about Agriculture related entities. Paper by Sharahchandra M. Lele [9] highlights the issue relating to sustainable development of Natural Resources using Semantic. MOST, a software framework for supporting modeling process also supports knowledge base relating to water management in Agriculture domain.

Agri QC by (S. Augustina Mary, Mela, 2011) also supports Knowledge Management System (KMS) which is highlighted with classification of queries for the Agriculture Knowledge Management System (Agri KMS) Development of Lyra Ontology Management system[4] highlights web-based visual tool for constructing models and automatically generating simulation code.

3. Refining business dynamics of Sugarcane industry using onto internet of things

India is the second largest producer of sugarcane in the world. During last two decades there are number of sugar mills that have cropped up in entire North India and Western India. Using combination of ontology, sugarcane, farming, GIS and internet of things with integration of SCADA we will be proposing a framework that can fine tune the sugarcane farming system and raw sugar processing.

To develop the coherency between the two entities we focus of Sugarcane Farming System (SFS).

3.1. Sugarcane Farming System

Organic Manures increases the soil health significantly sensor probes (fig. 2) helps in determining the level of productivity of soil. The basic idea is to give information to the Control Centre which finally passes the information through SMS to the farmer. For development of Soil Ontology and Sensor Ontology there are ontologies like Lyra ontology system (H. Beck et al., 2010)[4].

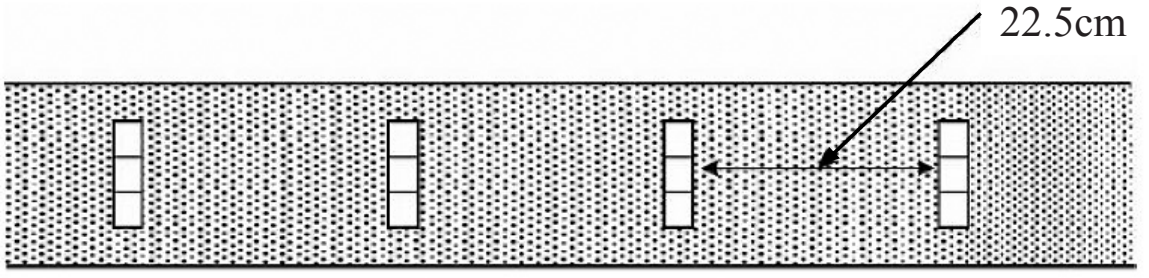

Fig. 1: Ferrous set placement

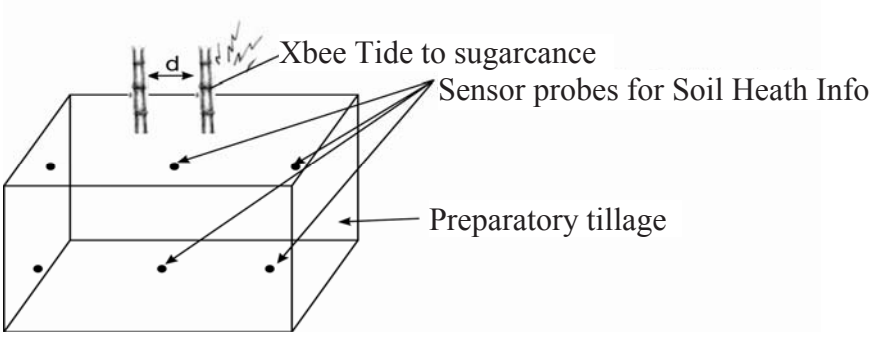

Fig. 2: A soil Cell (adopted from H. Beeket al., 2010) with sensors and Xbee Transreceiver

3.1.1. Raw Sugar Processing

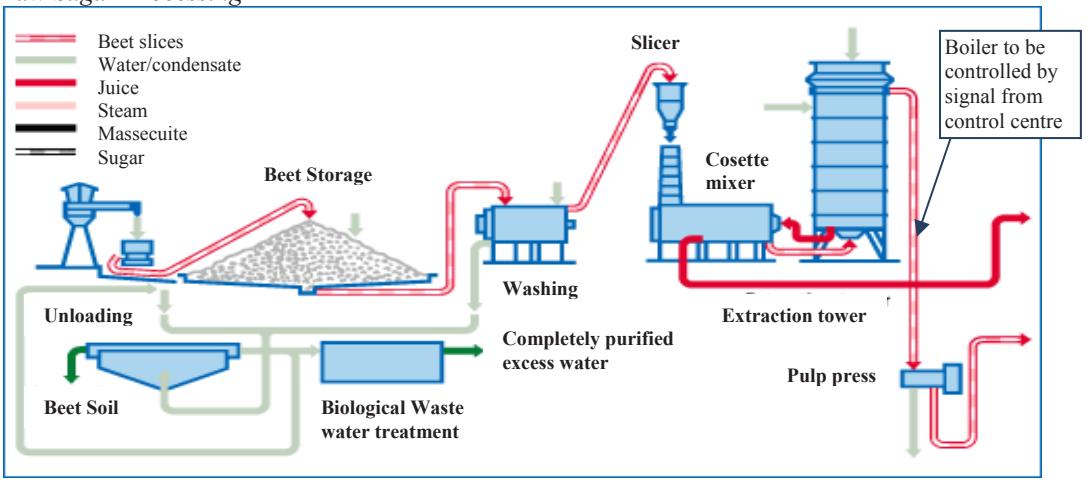

Fig. 3: Raw Sugar Processing

As shown in fig. 3 the process starts with crushing of sugarcane followed by the process of shredding the cane billets into fiber which is conveyed to the milling train for juice extraction. The shredded can is fed into the crushing mill consisting of three large rollers. It then dewaters the residual cane fiber which is used as a boiler fuel. Finally the steps like Filtration, Evaporation and Crystallization are done. The main idea is to

regulate the Boiler according to the harvest based on ontology. We will be able to automatically adjust the selling through Resource Description Foundation (RDF)[14] i.e. creation of Knowledgebase.

3.2. Control Centre

The main task of control centre as shown in fig. 4 is to receive signals from various sensors/ XBee and pass it so the SCADA system to monitor the control of boiler accordingly. Along with processing of signals it uses the techniques of Raster GIS to find out the harvest quality of sugarcane as shown in Fig. 5.

3.3. Development of Ontology

An ontology file[2,3] is an RDF description that contains all possible predicates for an application. It consists of vocabulary to define the domain and range of a predicate. By the help of ontology we can define the range to indicate that the predicate is of a particular data type. The ontology is a rhythmic taxonomic organization which allows categorisation of objects. From these taxonomic graphs we write RDF for control centre. Ontologies are nowadays providing a formal representation of objects and their relationships. The above flow control can be formalised by developing taxonomy.

We extend the simple ontology in RDF schemas using the basic principle.

Ontology is a triplet consisting of:

1. *Concepts = {Control Centre, SCADA, Boiler, Cloud, Sugar Mill, Sensor Network}*

it is a set of concepts of real world objects.

2. *Roles = {Controlling, Sensing}*
3. *Inheritance = {Sensor Network, Raster Images, Cloud, DNP3, Firing Controller Circuit}*

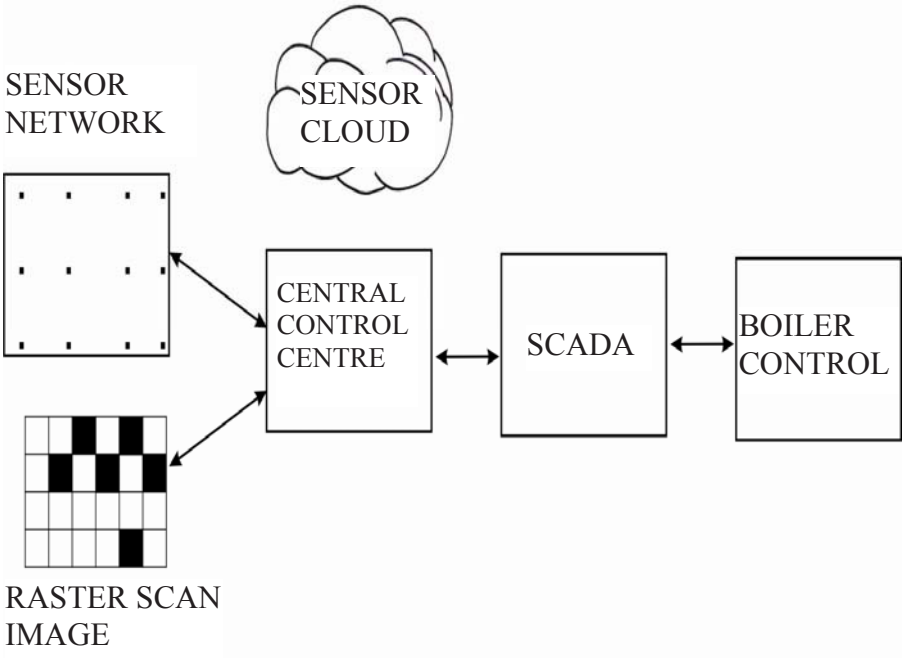

Fig. 4: Block Schematic of Flow Control

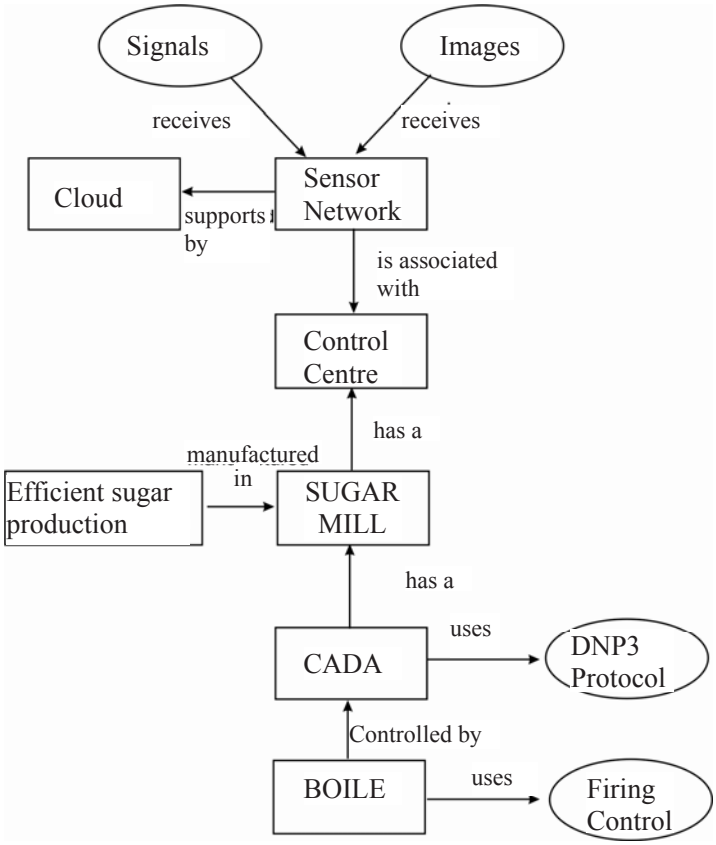

Fig. 5: A Simple Flow Control Ontology

rdf: RDF
xmlns: rdf = "http://www.w3.org/1999/02/22-rdf-ns#"
xmlns: rdfs = "http://www.w3.org/2000/01/rdf-schema#"
xmlns: owl = "http://www.w3.org/2002/07/owl #"
xmlns: dc = "http://sugarcane.org/dc/elements/1.1/"
xmlns: sugarcane = "http://www.linkeddatatools.com/sugarcane#">
<! OWL class definition- sugarcane Process Control --->
<owl: class rdf: about ="http://www.linkeddatatools.com/sugarcane# sugarmill">
<rdfs: label> sugar mill </rdfs: label >
</owl: class >
<! - - OWL Sub class definition - Controlcentre - - >
<owl: class rd?: about = "http://www.linkeddatatools.com/sugarcane# Control Centre">
<! - - Control Centre is a subclassification of Sugarmill - - >
<rdfs: subclass of rdf: resource =" "http://www.linkeddatatools.com/sugarcane# control centre"/>
<rdfs: label> Sensor Network </rdfs: label>
< rdfs: comment> Sensor Networks receives signals and Images
</rdfs: comments>
</owl: class >
<! - OWL Subclass Definition - SCADA - - >
< OWL: Class rdf: about = "http://www.linkeddatatools.com/sugarcane# sugarmill"/>
<rdfs: subclass of rdf: resource = " "http://www.linkeddatatools.com/SCADA# DNP3">

<rdfs: DNA3 is a protocol of SCADA to transmit signals
</ rdfs: comment>
</owl: class >
<! - - OWL subclass Definition - Boiler - - >
< rdfs: label > firing control </rdfs: Label >
< rdfs: comment > firing control of Boiler is done by signals from SCADA . </rdfs: comment>
</rdf: Description >
</rdf: RDF >

The above ontology links the sugar mills' website with the enhanced capability of web service and tries to relate the context depending on situation of thing. The sugar mills' website is linked with control centre which receives the signals from sensor informing about the current state of sugarcane yield and the raster image highlights the yield density to be processed in three stages as in fig. 6.

The cluster showing the good harvest support dark green color intimating the control centre to pass on the information to Mill during early start of the crushing. Secondly the message received through Xbee via Tera term on windows operating system needs to be sent through DNP3 protocol. XBee Tera term receives signals from other XBee arranged in Mesh Network as in fig. 7.

API format for Remote Transfer has the following fields starting with Delimiter, Length and Frame - specific data. DNP3 message passing between device and control centre is achieved via public switched telephone network (PSTN).The whole automation process is being achieved by the help. Smart web service start with context of things service, domain knowledge service which provides an update of new developments in sugarcane farming and end up in energy efficient control of Boilers. It provides a sustainable method of achieving the overall efficiency of the system.

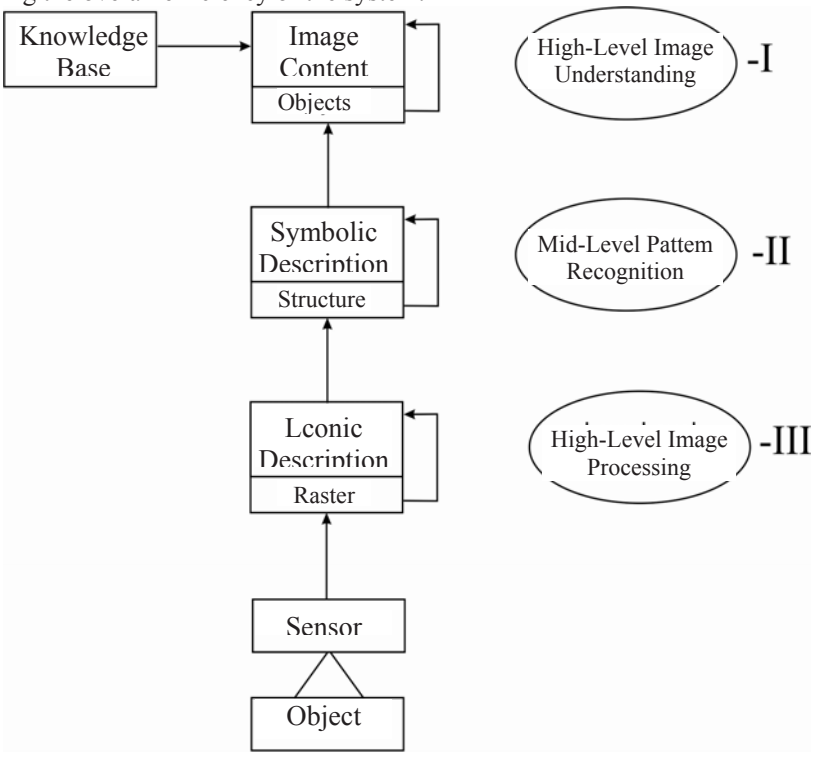

Fig. 6: Information extraction (Adapted from Ehlers et al. 1989)

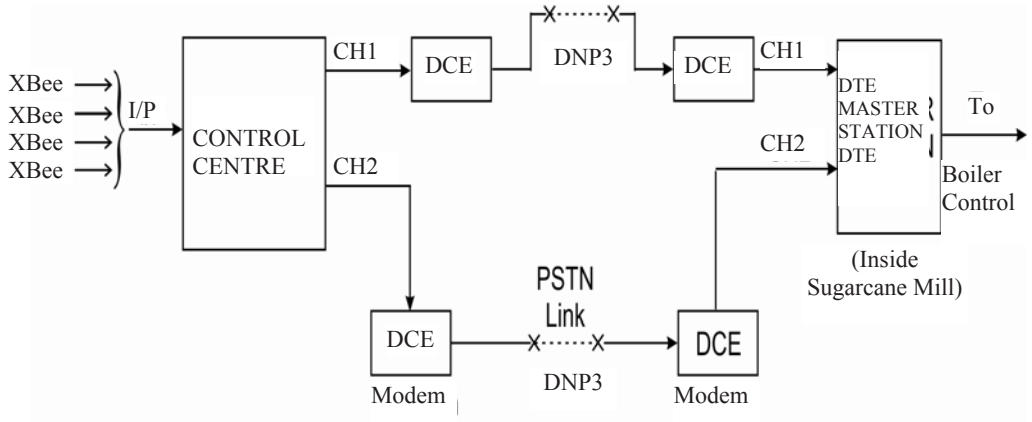

Fig. 7: Message Passing between XBee to Boiler Control

4. Conclusion

The paper presents a novel idea of creating sustainable framework which using the concept of context of things and ubiquitous environment. The two entities are integrated using ontology which provides a ubiquitous web service environment for sugarcane industry.

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